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STUDY OF THE VALIDITY OF TECHNIQUES ELECTROCHEMICAL IN THE CORROSION OF REBARS EMBEDDED IN MORTAR SPECIMENS WITH SLAG LFS

Prieto Barrio, M. I. (1), Cobo Escamilla, A. (1) Rodríguez Sáiz, A. (2) and González García, M. N. (1)

(1) Universidad Politécnica de Madrid. mariaisabel.prieto@upm.es
(2) Universidad Politécnica de Burgos

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1. Introduction

The durability of concrete is essential to ensure the life for which it was designed. To this end one of the most important factors is reinforcement corrosion [1]. Initially corrosion processes were analyzed by gravimetric techniques, but since the mid-twentieth century, electrochemical techniques are used to study corrosion. Electrochemical techniques have played a very important role because its accuracy is much higher than the gravimetric technique, and allows measurements as often as necessary [2]. Although there are studies examining the correlation between these methods in reinforced concrete used normally, no studies correlating the results obtained by both methods [3] in a mortar in which White ladle furnace slag (LFS) are incorporated. Steel production generates tons of slag, which are considered waste and causing serious environmental [4]. Considering these aspects, the study aims to test the validity of using electrochemical techniques in the analysis of corrosion of reinforcement embedded in mortar specimens with LFS as dross compared with gravimetric techniques.

2. Methods

In this research, tests with two series of specimens were performed of mortar (dimensions 6x8x2cm^3) with Portland cement CEM I / 42.5 R, urban potable water, sand, white ladle furnace slag (LFS), retarders and different percentages of chloride ion, as shown in Table 1.

Label	Description	w/c
MBE-0,0	Replacement of cement (30%) and sand (25%) by LFS + plasticizer (0,15%) + retardant (0,5%)	1,48
MBE-0,4	Replacement of cement (30%) and sand (25%) by LFS + plasticizer (0,15%) + retardant (0,5%) + chloride ion (0,4%)	1,48
MBE-0,8	Replacement of cement (30%) and sand (25%) by LFS + plasticizer (0,15%) + retardant (0,5%) + chloride ion (0,8%)	1,48
MBE-1,2	Replacement of cement (30%) and sand (25%) by LFS + plasticizer (0,15%) + retardant (0,5%) + chloride ion (1,2%)	1,48
MBE-2,0	Replacement of cement (30%) and sand (25%) by LFS + plasticizer (0,15%) + retardant (0,5%) + chloride ion (2,0%)	1,48

Table 1 Dosages of the specimens

For comparing the validity of electrochemical methods in the corrosion study of mortars with slag LFS, we measure potential and corrosion rates using electrochemical techniques (polarization curve) with AUTOLAB / PGSTAT302N potentiostat. With the reference electrode used (SSCE; +0,222V SHE), more negative potentials that -231mV involve corrosion risk associated 90%. Moreover, corrosion rate exceeding 1μA/cm^2 significantly reduce the durability of reinforced concrete structures, if it is maintained over time. After obtaining sufficient data to evaluate the corrosion behavior of different specimens using

electrochemical techniques, we proceeded to quantify by gravimetric mass loss experienced by the bars.

3. Results and Discussion

Figure 1 shows the relationship between the potential and the corrosion rate. As can be seen both measures are directly related. It is the highest corrosion rate that corresponds to more negative corrosion potential and higher percentages of chloride ion. Specimens with percentages of chloride ions above the limit set by the EHE, are in active state, while samples without chlorides or with 0.4% chloride ion by weight of cement, are in passive state.

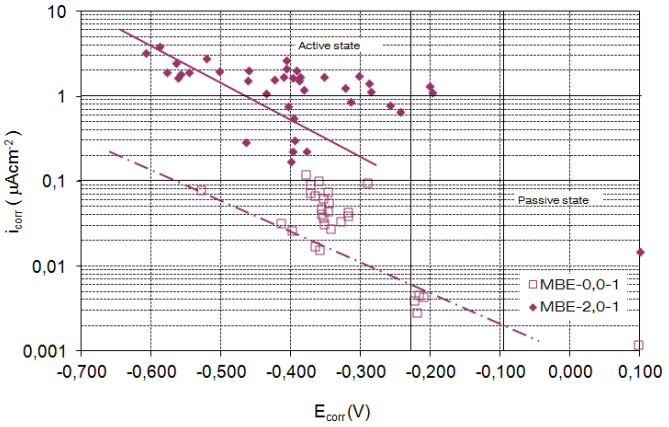

Figure 1 Relation between the corrosion potential and corrosion rate

Figure 2 shows the relation between mass loss experienced by the bars and the corrosion rate in the slag specimens with slag LFS. As can be seen, the specimens with higher corrosion rate are experiencing greater loss of mass. The corrosion behavior shown by the electrochemical and gravimetric techniques is similar.

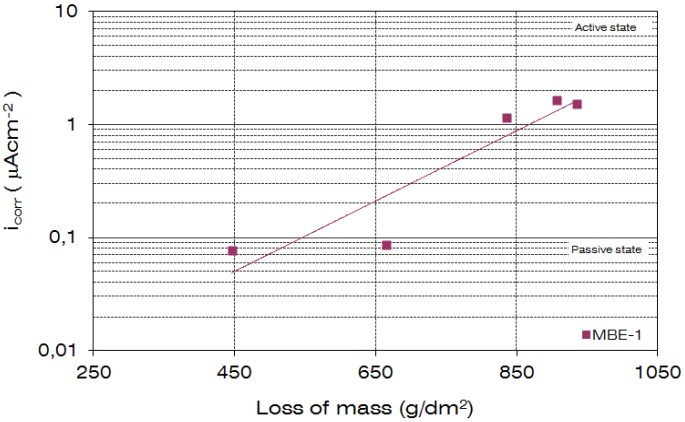

Figure 2 Relation between corrosion rate and the loss of mass

4. Conclusions

- In specimens with white ladle furnace slag, the corrosion potential and the corrosion rate increases with the percentage of chloride ion by weight of cement introduced at the time of kneading.

- The corrosion behavior of mortars without chlorides or percentages of 0,4% by weight of cement, limit set by the EHE instruction, presents corrosion rates specific of passive state, while for mortars with percentages of chloride ion of 0,8, 1,2 and 2,0%, the reinforcing steel corrosion rates are specific of active state.

- The values obtained for determining the corrosion behavior of steel bars by gravimetric and electrochemical techniques have been consistent, hence we can conclude that electrochemical methods are valid for the study of corrosion in slag Mortar LFS.

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